Proposed additions to the 2005 Building Energy Efficiency Standards

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Description

Incorporate an under sink automatic hot water recirculation systems as a standard in the Title 24 water heating guidelines. The under sink hot water recirculation system is **NOT** a standard hot water circulation system that requires a dedicated return line – one which must be built during initial construction. This system can be retrofitted into any existing home/building at very minimal cost, thereby having an immediate impact on the entire nation.

Benefits

The average family dumps a minimum of 15,000 gallons of water down the drain every year while waiting for hot water to arrive at a faucet or water outlet. This same unfortunate dynamic is experienced in apartments, commercial buildings, and anywhere people have a need for hot water. By adding a "hot water recirculation system" to a home, business, commercial building, etc., wasted natural resources and wasted energy can be radically reduced. Hot water recirculation systems are excellent in reducing energy consumption and pay for themselves in expended energy and resource cost savings. In addition to wasting water, a very precious resource, people are also spending $150.00 to $500.00 per year in additional energy consumption costs during the process.

Environmental Impact

When combined, wasted water, sewer, electricity, natural gas, and related charges and taxes can add up to a significant amount of money and account for a huge burden on California's stressed utilities and resource providers. On a brighter note, this wasted energy and the associated cost(s) to the public can be turned into a significant annual savings by using existing technology and readily available consumer products. Consider the following example:

- 12,000 gallons is the very minimum amount of water wasted annually by a family of four. Not only is this a waste of water but also creates a need for the waste water to be treated.
- This waste creates significant energy consumption costs as listed in the attached documentation
- If 1,000,000 homes/business in California were to install an **AUTOCIRC©**, the average result in water savings is a minimum of 12 billion gallons annually and between $250,000,000 and $400,000,000 annually. ***No less important than the dollar savings is the actual energy and resource savings.***

Type of Change

This would be a modeling change. It would modify the existing water heater performance calculations. It would not add a compliance option or a new requirement but would affect the way the tradeoffs are made.

Measure of Availability and Cost

The component parts for hot water recirculation systems are readily available at all major plumbing wholesale distributors as well as major retailers such as Home Depot or Lowes. Many systems are available for as little as $200.00.

Useful life, Persistence and Maintenance

The system is part of the plumbing system of the home and would require no more maintenance than a home without a recirculation system. The system is basically maintenance free The energy savings will be present for the life of the home.

Performance Verification

In an effort to provide a greater level of analysis supporting the math used to determine energy and cost savings, the following formula(s) is available for your review. Please keep in mind that a plethora of documentation is available for your scrutiny to statistically support the aforementioned subject matter.

Dollars saved per year = [1#] + [2#] + [3#] − [4#] − [5#]

[1#] = Cost of water saved = $\frac{\text{11,970 gal/year x water cost including taxes \$/100 Ft}^3}{\text{7.48 gal/Ft}^3 \text{ x } 100}$

Assumed cost of water = $2.02/100 Ft^3

Assumed water saved using Autocirc pump – 11,970 gallons/year

[2#] = Sewer surcharge cost for wasted water =

$\frac{\text{11,970 gal/year x sewer surcharge cost including taxes \$/100 Ft}^3}{\text{7.48 gal/Ft}^3 \text{ x } 100}$

Assumed sewer surcharge cost for wasted water − $1.35/100 Ft^3

[3#] = Cost to heat wasted water =

$\frac{\text{Gallons of water saved/year x weight of water x temperature rise x electrical cost including taxes \$/kWh}}{\text{Water heater efficiency x conversion btu/kWh}}$

$= \frac{\text{11,970 gal/year x 8.33 \#/gal x 100° F. temperature rise x electrical cost including taxes \$/kWh}}{\text{1.0 water heater efficiency x 3,413 btu/kWh}}$

Weight of water = 8.33#/gal

Temperature rise = Assumed 100° F. [40° − 140°]

Water heater efficiency = assumed 100%

Conversion of btu's to kWh = 3,413.0 btu's/kWh

[4#] = Cost to operate pump =

Electrical consumption of pump watts x hours of operation of pump x electrical cost including taxes $/kWh

Conversion from watts to kilowatts =

$\frac{\text{33 watts x 1.07 hours/day x 350 days/year x electrical cost including taxes \$/kWh}}{\text{1,000 watts/kiwi}}$

Electrical consumption of pump = 33 watts

Assumed hours of operation of pump =

$\frac{\text{16-hours/day time clock x 4 minutes/hour pump runs}}{\text{60 minutes/hour}} =$ 1.07 hours/day for operation of pump

[5#] = Cost for piping energy loses (radiated & convected) which must be replenished by the water heater

$= \frac{\text{Length of piping x piping heat loss/Ft x hours/day x days/year x electrical cost including taxes \$/kWh}}{\text{Water heater efficiency x conversion btu's to kWh}}$

Energy losses occur each time hot water is used at a faucet. Therefore, additional piping energy loss due to Autocirc pumping is 10 btu/hr/Ft (Assumed)

$$= \frac{60 \text{ Ft} \times 10 \text{ ft/hour/Ft} \times 16 \text{ hours/day} \times 350 \text{ days/year} \times \text{electrical cost including taxes } \$/\text{kWh}}{1.0 \times 3{,}413.0 \text{ Btu's/kWh}}$$

Assumed 60 Ft of 3/4" annulated hot water supply piping

Cost Effectiveness

Most hot water recirculation systems can pay for themselves in a relatively short period of time. In most cases less than one year. Hot water recirculation systems are excellent in reducing energy consumption and pay for themselves in expended energy and resource cost savings.

Consider the following example:

- 12,000 gallons is the very minimum amount of water wasted annually by a family of four
- This waste creates significant energy consumption costs as listed in the attached documentation
- If 1,000,000 homes/business in Washington were to install an **AUTOCIRC©**, the average result in water savings is a minimum of 12 billion gallons annually and between $250,000,000 and $400,000,000 annually. ***No less important than the dollar savings is the actual energy and resource savings.***

Analysis Tools

A comparison would need to be done of water and utility bills of homes or commercial buildings with a hot water recirculation versus comparable buildings without recirculation systems. Test data on water and energy savings already exists in several California communities. For example Cambria and Oceanside, California.

Relationship to Other Measures

The water saving capacity of a hot water recirculation system could be directly tied to water conservation measures being considered for landscaping, washing machines, low flush toilets and low flow showerheads and faucets.

Bibliography

1. Cost Analysis Study of Hot Water Recirculation Systems prepared by Edward Saltzberg and Assoc. 5/98. Details the water and energy saving capacity of various hot water recirculation systems
2. "Domestic Hot Water Design Manual" 1998 published by American Society of Plumbing Engineers. Outlines the costs and saving associated with hot water recirculation systems. Outlines various control strategies for hot water recirculation systems.
3. New York Sate Energy Research and Development Authority Report Brief on Domestic Hot Water Recirculation Systems. Report #99-1. Outlines control strategies for hot water recirculation systems.

In addition industry standards should be review from the following organizations:

- IAPMO
- PHCC
- ASPE